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ABSTRACT

The role of color used in graphics in facilitating recall of verbal material was studied in a follow-up to previous research on the use of a color code in graphics presentations. An analysis of variance for repeated measures was used to test the hypothesis that significant interactions and differences would occur. Independent variables manipulated were the type of graphic presentation, the type of graphic assessment, and the time of testing. The two presentation and assessment types were systematically color-coded and black and white, and the times of testing were immediate and a 2-week delay. The dependent variable, recall/retention, was measured by achievement in remembering. Subjects were 215 seventh graders from a junior high school in the Midwest, each randomly assigned to one of four treatment groups. The sample was adjusted to include 30 students each from 9 homerooms. The major finding was that the important factor in enhancing performance appears to be the presence of a systematic color code in graphic presentation. The combination of color presentation and color assessment produced the best performance. Implications for future research are discussed. Four tables present study data. (Contains 11 references.) (SLD)

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The Effects of a Color Code Used in Graphics on the Recall of Verbal Material

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by
Peggy A. P. Pruisner

Introduction

"It is impossible to say how first the idea entered my brain; but once conceived, it haunted me day and night."

These words of the possessed main character in Edgar Allan Poe's "The Tell Tale Heart" seem appropriate for those of us who find a compelling area of study or avenue for research. They seem particularly poignant for those researchers driven by the questions surrounding the role of color in learning as Curtiss (1987, p. 35) states, "Color is the sensation aroused in one's mind." This haunting passion has led to a continuing line of research.

The initial study (Pruisner, 1992), "The Effects of the Use of a Color Code in Graphic Presentation and Assessment on the Reader's Immediate Recall and Delayed Retention," evolved from the researcher's concern for the increasing requirements of literacy (Venezky, 1990) that are necessary for the reader to make sense of the world. Among those requirements, visual literacy, the ability to understand and make visual messages (Dondis, 1973), is an integral part of the reading process that enables a contemporary learner to successfully interpret the broadening context of our information environment. Also of concern are the potential for and reluctance of educators to manipulate and interact with the features or characteristics of graphics and to consider instruction aimed at developing visual literacy as essential across the curriculum (Robinson, 1991).

Color, one of the most significant and perhaps interesting features of text with the potential to be manipulated to the reader's advantage, is among the least understood, supported by contradictory and confusing research. Evolving from noteworthy, classic studies where color was coded in graphic study materials (Dwyer and Lamberski, 1982-83), the continuing study into the manipulation of color to enhance learning in an increasingly complex information environment is worthwhile. This second study attempts to further isolate color as applied to learning from graphics by eliminating the oral retelling of the myth used prior to the reading of the myth and accompanying graphic in the first study.

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Methodology

Statement of the Problem

In response to the contemporary reader's need to interpret graphics in our broad information environment, research stresses the need for and importance of well-designed graphics (Gerber, 1985; Kostelnick, 1988; Peterson, 1983). Empirical research needs to be conducted to determine the effects of the manipulation of graphic features on reading (Hartley, 1986), graphical comprehension (Peterson, 1983; Soderston, 1983), and instruction.

Research Questions

The following research questions were investigated in both the initial research and this subsequent study:

1. Is there a significant interaction among the graphic presentation type (systematically color-coded or black/white), the graphic assessment type (systematically color-coded or black/white), and the time of testing (immediate recall or delayed retention) of verbal material?
2. Is there a significant interaction between the graphic presentation type (systematically color-coded or black/white) and the graphic assessment type (systematically color-coded or black/white) when immediate recall of verbal material is tested?
3. Is there a significant interaction between the graphic presentation type (systematically color-coded or black/white) and the graphic assessment type (systematically color-coded or black/white) when delayed retention of verbal material is tested?
4. Is there a significant difference in recall of verbal material between those given a systematically color-coded graphic presentation and those given a black/white graphic presentation?
5. Is there a significant difference in retention of verbal material between those given a systematically color-coded graphic presentation and those given a black/white graphic presentation?
6. Is there a significant difference in recall of verbal material between those given a systematically color-coded graphic assessment and those given a black/white graphic assessment?
7. Is there a significant difference in retention of verbal material between those given a systematically color-coded graphic assessment and those given a black/white graphic assessment?

Research Design

An analysis of variance for repeated measures was used to test the hypotheses that significant interactions and differences would occur. The independent variables manipulated were the type of graphic presentation, the type of graphic assessment, and time of testing. The two presentation and assessment types were systematically color-coded and black/white, and the two times of testing included immediate recall and 2-week delayed retention. The dependent variable, recall/retention on the assessment graphic, was measured by achievement, the number of characters, actions, and explanations that were remembered and recorded as stated on a

graphic presentation summarizing a little-known Norse myth. To accommodate three independent variables, with two levels each, a 2x2x2 (presentation x assessment x time of testing) was used. Presentation type and assessment type were the between-subjects factors, and recall/retention was the within-subjects factor.

Subjects

The entire seventh-grade class from a Midwest junior high school with 641 students in grades 7-9 was used in this study. The nine seventh-grade homerooms, containing a total of 215 students, were randomly assigned to one of four treatment groups (adjusted n = 30).

Treatment Groups

The four treatment groups received the following:

1. Color-coded presentation, color-coded assessment
2. Color-coded presentation, black/white assessment
3. Black/white presentation, color-coded assessment
4. Black/white presentation, black/white assessment.

Procedure

During their homeroom session, all students received directions via audiotape; they then read and studied the graphic presentation in isolation. Finally, they demonstrated both immediate recall and 2-week delayed retention on the graphic assessment without the aid of the presentation graphic.

Materials

Following the directions, subjects were given the presentation graphic. The graphic design was the same on all presentations and assessments. The form of the graphic was a unique design created by the researcher to prevent the subjects from having prior experience with the graphic. The systematic color code was explained to all subjects who received color presentations and was selected to create a pattern in the reader's mind.

Scoring of the instrument

All assessments were scored by two raters to ensure accuracy. One point was given for each correct word or acceptable synonym. One point was given for each box or area where all words were written in order and spelled correctly. One point was given for each word or phrase that was placed in the correct box or area.

Results

Based on the results of the analysis of variance with the level of significance established at the .05 level, there was not a significant three-way interaction among the graphic presentation and the graphic assessment and the time of testing (see Table 1). The supporting evidence, the means and standard deviations for the four treatment groups, is graphically displayed in Table 2.

Table 1.

Repeated Measures Analysis of Variance, MANOVA Test Criteria and Exact F Statistics

	Value	F	Prob.	Sig.
Time x presentation	.99	.18	.67	NS
Time x assessment	.99	.94	.33	NS
Time x presentation x assessment	.99	.52	.47	NS

Table 2.

Mean Performance at Recall and Retention for Each Treatment Group

Group	Time of Testing			
	Recall		Retention	
	M	SD	M	SD
Color presentation				
Color assessment	58.70	(14.60)	25.13	(15.72)
Black/white assessment	48.40	(18.74)	19.43	(15.44)
Black/white presentation				
Color assessment	45.20	(17.79)	12.43	(12.00)
Black/white assessment	48.23	(16.00)	16.13	(17.51)

Note. n = 30 for each group

The analysis of between subjects effects indicated the presence of a significant two-way interaction between graphic presentation type and graphic assessment type. Also, presentation alone was the significant factor (see Table 3).

Table 3.

Analysis of Variance, Tests of Hypotheses for Between Subjects Effects

Source of of variation	df	Sum of squares	Mean square	Prob.	F	Sig.
Presentation	1	3300.42	3300.42	8.10	.01	SIG
Assessment	1	322.02	322.02	.78	.38	NS
Presentation x Assessment	1	1938.02	1938.02	4.76	.03	SIG

By reviewing the mean performance at recall and retention as a function of the type of presentation graphic, it can be determined that the preferred presentation type was color-coded (see Table 4).

Table 4.

Mean Performance at Recall and Retention as a Function of Type of Presentation Graphic

	Presentation Type	
	Color	Black/white
Recall	53.55	46.72
Retention	22.28	14.28

Note. n = 60 for each group.

Consequently, there was one major finding of this study: the important factor in enhancing performance appeared to be the presence of a systematic color code in graphic presentation. The combination of color presentation and color assessment produced the best performance of all combinations.

Recommendations for Practice

Because the use of color had an impact on the recall of verbal information presented in graphic form, the use of color in graphics should be considered when developing curriculum, planning instruction, and designing text. Designers, teachers, and students

must let the purpose of the graphic determine the color code. The code should be thoughtfully created to enhance and extend schema development and fully explained to facilitate learning and retention of verbal material and thereby promote literacy.

Implications for Future Research

To continue this line of research, it is recommended that future study focus on color and graphics:

1. Research should be conducted to investigate how skilled readers use color to remember patterns in schemata. This research should include quantitative research, qualitative ethnographic research, and case studies of readers considered to be at an expert level. The results would have implications for the graphic schema strategies we teach to students.

2. Research should include the use of a color code in other graphic presentations and assessments to see if similar results are produced using a variety of both new and familiar graphic presentations and assessments.

3. Research should include experimentation with both cuing and systematic coding using different colors and varying numbers of colors in graphic background and print to see what impact these variables have on immediate recall and delayed retention.

4. Finally, there should be further research into the other features of graphic presentation and assessment to determine the comparative efficacy of other graphic features in tapping and developing schemata. This research should indicate whether other features in the graphic design are effective in producing increased immediate recall and delayed retention of verbal material presented in graphic form. The results of further research would provide valuable information for readers, teachers, and designers of curricular materials at all levels of the learning spectrum.

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